Hashem M. Mourad

Fluid Dynamics & Solid Mechanics Group (T-3)
Theoretical Division
Los Alamos National Laboratory
Mail Stop B216, Los Alamos, NM 87545

phone: 505·606·2188
fax: 505·665·5926
email: hmourad@lanl.gov
web: http://public.lanl.gov/hmourad

Education

University of Michigan — Ann Arbor, MI
Ph.D. in Mechanical Engineering — 12·2004

- Dissertation title: A continuum approach to the modeling of microstructural evolution in polycrystalline solids.
- Advisor: Prof. Krishna Garikipati.

The American University in Cairo — Cairo, Egypt
M.S. in Engineering — 01·2000

- Thesis title: Elastic-plastic behavior and limit-load analysis of pipe bends under out-of-plane moment loading and internal pressure.

B.S. in Engineering — 06·1996

- Major: Mechanical Engineering (concentration area: Design).
- Minors: Electronics, Computer Science.

Research Experience

Los Alamos National Laboratory, Theoretical Division — Los Alamos, NM
Technical Staff Member / Scientist 2 — 03·2008 – present
Post-doctoral Research Associate — 05·2006 – 02·2008

Current work involves the development of analytical and computational tools to study the dynamic behavior and/or failure of materials and structures under extreme loading conditions, taking into consideration the relevant shock physics, finite-deformation kinematics, and history-dependent mechanisms such as plasticity and damage. Particular focus areas include:

- Dynamic strain localization and damage evolution in polycrystalline materials subjected to complex thermo-mechanical loads.
- Modeling the response/failure of laminated composite plates/shells under dynamic loading conditions, including ballistic impact and/or blast loading.

Duke University, Civil & Environmental Engineering Department — Durham, NC
Post-doctoral Research Associate — 09·2004 – 04·2006

Finite element techniques were developed for the treatment of evolving-interface problems, e.g. fluid-structure interaction, phase change, void/crack evolution. Embedded-interface methods were used to eliminate the need for the explicit, conforming meshing of interfaces in such problems. Attention was focused on robust level set algorithms for interface tracking and on stabilized mixed methods for enforcing interfacial constraints using Lagrange multipliers.

University of Michigan, Mechanical Engineering Department — Ann Arbor, MI
Graduate Research Assistant — 01·2001 – 08·2004

A continuum formulation was developed to model phenomena in which the coupling between mechanics and composition plays a major role, e.g. void nucleation. This work was also extended to make use of the level set method in modeling phenomena involving moving interfaces, such as grain-boundary migration. The formulation was implemented in a finite element framework using advanced techniques (mixed methods, spatial stabilization, staggering of coupled equations) and was used to treat a range of microstructural evolution phenomena.

The American University in Cairo, Engineering Department Cairo, Egypt

Graduate Research Assistant 09·1996 – 12·1999

> A large-deformation finite element analysis was conducted to study the elastic-plastic behavior and estimate the limit loads of pipe bends under out-of-plane moment loading and internal pressure. Cross-sectional deformation, the distributions of stress and strain at different loading stages, yield progression and the effects of modeling parameters were all studied in detail.

Teaching and Mentoring

University of Michigan, Mechanical Engineering Department Ann Arbor, MI

Graduate Student Instructor Winter 2004

- ME-382: Mechanical Behavior of Materials

The American University in Cairo, Engineering Department Cairo, Egypt

CAD/FEM Laboratory Assistant Winter 1996

- MENG-453: Finite Element Method and Applications in Design
- MENG-490/MENG-491: Senior Project (thesis) I/II

Industry Experience

StarNet Internet Services Cairo, Egypt

Networks & UNIX-Systems Administrator 06·1996 – 01·2000

Professional Systems and Laboratories Giza, Egypt

Technical Support Engineer, CAD/CAM & CNC Systems 05·1997 – 11·1998

Honors and Awards

- Mechanical Engineering Departmental Fellowship, University of Michigan, 2000 – 2001.
- Outstanding Design and Analysis Paper, ASME Pressure Vessels and Piping division, 2000.
- *Cum Laude*, The American University in Cairo, 1996.
- Dean's List, The American University in Cairo, 1991 – 1996.

Professional Affiliations and Service Activities

- Member, American Society of Mechanical Engineers (ASME), 2000 – present.
- Member, Society of Engineering Science (SES), 2003 – present.
- Member, United States Association for Computational Mechanics (USACM), 2005 – present.
- Reviewer for the following archival journals: *Finite Elements in Analysis and Design, International Journal of Fracture, Journal of Applied Mechanics.*

Publications

Peer-reviewed Journal Articles

[9] H. M. Mourad, T. O. Williams, and F. L. Addessio, "Finite element analysis of inelastic laminated plates using a global–local formulation with delamination," *Computer Methods in Applied Mechanics and Engineering*, vol. 198, no. 3–4, pp. 542–554, 2008; `doi:10.1016/j.cma.2008.09.006`.

[8] H. M. Mourad, J. Dolbow, and I. Harari, "A bubble-stabilized finite element method for Dirichlet constraints on embedded interfaces," *International Journal for Numerical Methods in Engineering*, vol. 69, no. 4, pp. 772–793, 2007; `doi:10.1002/nme.1788`.

[7] H. M. Mourad and K. Garikipati, "Advances in the numerical treatment of grain-boundary migration: Coupling with mass transport and mechanics," *Computer Methods in Applied Mechanics and Engineering*, vol. 196, no. 1–3, pp. 595–607, 2006; `doi:10.1016/j.cma.2006.06.005`.

[6] H. Ji, H. Mourad, E. Fried, and J. Dolbow, "Kinetics of thermally-induced swelling of hydrogels," *International Journal of Solids and Structures*, vol. 43, no. 7–8, pp. 1878–1907, 2006; `doi:10.1016/j.ijsolstr.2005.03.031`.

[5] H. M. Mourad, J. Dolbow, and K. Garikipati, "An assumed-gradient finite element method for the level set equation," *International Journal for Numerical Methods in Engineering*, vol. 64, no. 8, pp. 1009–1032, 2005; `doi:10.1002/nme.1395`.

[4] G. Bohrer, H. Mourad, T. Laursen, D. Drewry, R. Avissar, D. Poggi, R. Oren, and G. G. Katul, "Finite-Element Tree Crown Hydrodynamics model (FETCH) using porous media flow within branching elements—a new representation of tree hydrodynamics," *Water Resources Research*, vol. 41, no. 11, p. W11404, 2005; `doi:10.1029/2005wr004181`.

[3] H. M. Mourad and M. Y. A. Younan, "Limit-load analysis of pipe bends under out-of-plane moment loading and internal pressure," *Journal of Pressure Vessel Technology, Transactions of the ASME*, vol. 124, no. 1, pp. 32–37, 2002; `doi:10.1115/1.1425807`.

[2] H. M. Mourad and M. Y. A. Younan, "Nonlinear analysis of pipe bends subjected to out-of-plane moment loading and internal pressure," *Journal of Pressure Vessel Technology, Transactions of the ASME*, vol. 123, no. 2, pp. 253–258, 2001; `doi:10.1115/1.1310335`.

[1] H. M. Mourad and M. Y. A. Younan, "The effect of modeling parameters on the predicted limit loads for pipe bends subjected to out-of-plane moment loading and internal pressure," *Journal of Pressure Vessel Technology, Transactions of the ASME*, vol. 122, no. 4, pp. 450–456, 2000; `doi:10.1115/1.1310334`.

Book Chapters

[1] H. M. Mourad, T. O. Williams, and F. L. Addessio, "A computational framework for multiscale analysis of laminated composite plates," in *Advances in Mathematical Modeling and Experimental Methods for Materials and Structures*, R. Gilat and L. Banks-Sills, Eds. New York: Springer, 2010, pp. 131–144; `doi:10.1007/978-90-481-3467-0_10`.

Conference Papers

[1] H. M. Mourad and K. Garikipati, "Modeling of coupled self-diffusion and mechanics in polycrystalline solids," in *Proceedings of the Sixth World Congress on Computational Mechanics* [CDROM], Beijing, China, September 5–10, 2004.

Conference Abstracts

[6] H. Mourad, T. Williams, and F. Addessio, "Finite element analysis of inelastic laminated plates using a global–local formulation with delamination," in *Proceedings of the 45th Annual Technical Meeting of the Society of Engineering Science* [CDROM], Champaign, Illinois, October 12–15, 2008.

[5] H. M. Mourad, T. O. Williams, and F. L. Addessio, "A global–local strategy for modeling the transient response of laminated composite plates," in *Proceedings of the 44th Annual Technical Meeting of the Society of Engineering Science* [CDROM], College Station, Texas, October 21–24, 2007.

[4] H. M. Mourad, J. Dolbow, and I. Harari, "A bubble-stabilized finite element method for imposing Dirichlet constraints on embedded interfaces," in *Proceedings of the Seventh World Congress on Computational Mechanics* [CDROM], Los Angeles, California, July 16–22, 2006.

[3] H. M. Mourad, J. Dolbow, and K. Garikipati, "A simple numerical solution scheme for the level set equation," in *Proceedings of the Eighth U.S. National Congress on Computational Mechanics* [CDROM], Austin, Texas, July 24–28, 2005.

[2] H. Mourad and K. Garikipati, "Modeling void nucleation in polycrystalline solids: The effect of compositional stress," in *Proceedings of the 40th Annual Technical Meeting of the Society of Engineering Science* [CDROM], Ann Arbor, Michigan, October 12–15, 2003.

[1] K. Garikipati and H. Mourad, "The influence of compositional stress on self-diffusion and voiding in crystalline thin films: A theoretical treatment," in *Abstracts of the 2002 MRS Fall Meeting*, p. 513, Boston, Massachusetts, December 2–6, 2002.

Technical Reports and Special Publications

[2] C. A. Bronkhorst, A. R. Ross, B. L. Hansen, H. M. Mourad, E. K. Cerreta, and J. F. Bingert, "Modeling and characterization of grain scale strain distribution in polycrystalline tantalum," in *ADTSC Science Highlights 2010*, Los Alamos National Laboratory, LA-UR-10-01992, pp. 116–117, 2010.

[1] H. M. Mourad, T. O. Williams, and F. L. Addessio, "Global–local analysis of laminated composite plates," in *ADTSC Science Highlights 2008*, Los Alamos National Laboratory, LA-UR-08-1690, pp. 168–169, 2008.